



# Silicon Management

Alice Bean

Univ. of Kansas/Fermilab

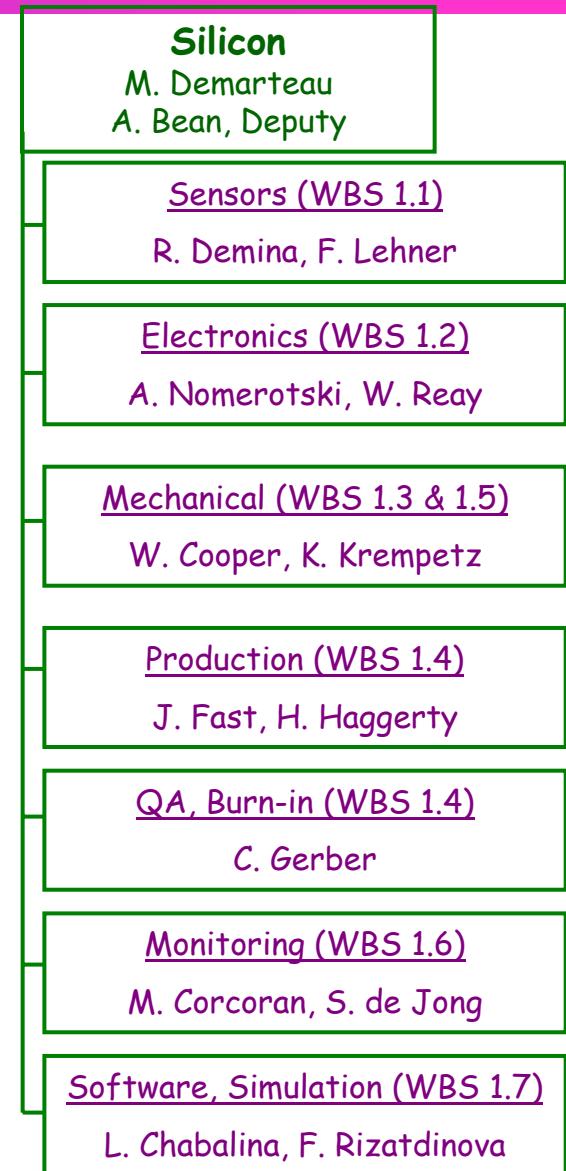
## Outline

- Organization and Management
- Schedule
- Costs
- Labor Profiles
- Risk Analysis
- Conclusions



# Organization

- Seven distinct Level 3 groups within the project each with its own L3 managers
- Management
  - ◆ Silicon group as a whole meets bi-weekly
  - ◆ Silicon L2 and L3 managers meet bi-weekly
- Subgroups
  - ◆ In addition many subgroups meet regularly
- We've built a strong collaboration with major participation from various university groups with clearly delineated responsibilities.



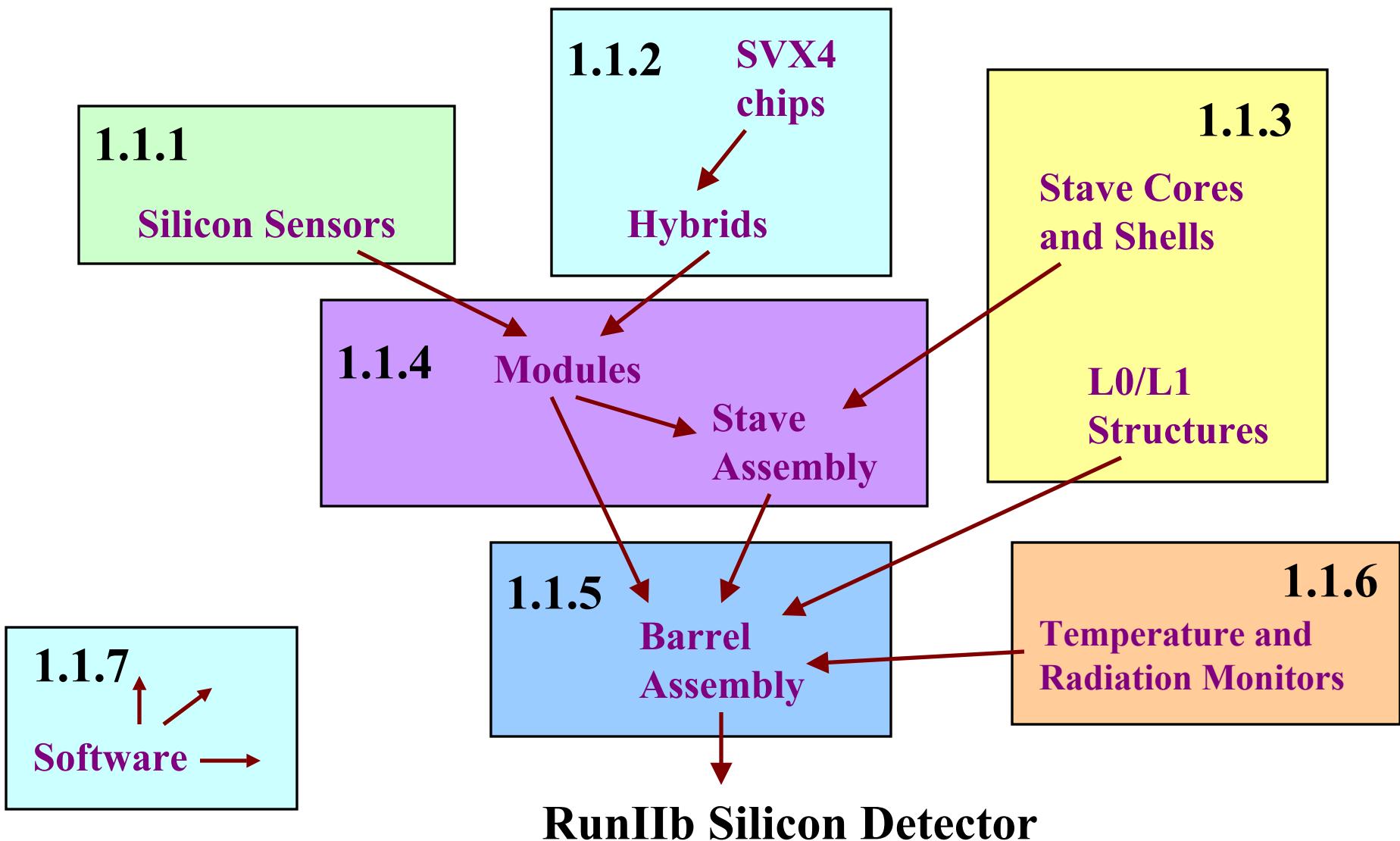


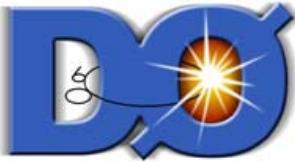
# University Contributions

- Sensor Testing
  - ◆ KSU, SUNY StonyBrook, CINVESTAV, Moscow State Univ
- Readout Electronics
  - ◆ KSU, Kansas, UIC, Fresno State, Brown, Louisiana Tech, Northwestern
- Mechanical Design and Fabrication
  - ◆ Univ. of Washington, Michigan State Univ.
- Monitoring
  - ◆ NIKHEF, Rice Univ.



# Production Line





# Schedule Overview

- Relies on RunIIa experience
  - ◆ Build up unparalleled infrastructure and expertise at SiDet
  - ◆ Significant experience with Carbon Fiber at Lab 3
  - ◆ Some new elements similar to systems employed in RunIIa
    - »Digital jumper cables versus low mass cables in RunIIa
  - ◆ Some elements retained from RunIIa
    - »All of the downstream readout electronics
      - ✿ Interface boards, sequencers, VRB's, VTM's ,HV system
- Schedule is an honest estimate of time evolution of the project
- Schedule recognizes that there is pressure to stay on track
- It does not cover to the most extreme "what if" scenarios.



# Example Task

## 10/10 Axial Module Production – WBS 1.1.4.14.2.2

ID	WBS	Task Name	Duration	Start	Finish	Predecessors	M&S Cost \$	Fu	Resource Names
668	<b>1.1.4.14</b>	<b>10/10 Axial Modules</b>	<b>96.2 w</b>	<b>Fri 12/13/02</b>	<b>Thu 11/18/04</b>		<b>\$1,540.00</b>	<b>2U</b>	
669	1.1.4.14.1	Develop electrical module preproduction	8 w	Fri 12/13/02	Tue 2/18/03	78SS+2 w,202S	\$130.00	3U	PhysicistF,MechTechS
670	<b>1.1.4.14.2</b>	<b>South</b>	<b>18.2 w</b>	<b>Tue 3/30/04</b>	<b>Thu 8/5/04</b>		<b>\$705.00</b>	<b>2U</b>	
671	<b>1.1.4.14.2.1</b>	<b>L2-5 (10/10 South Axial) Module Prod</b>	<b>0 w</b>	<b>Tue 3/30/04</b>	<b>Tue 3/30/04</b>	<b>672SS</b>	<b>\$0.00</b>	<b>2U</b>	
672	<b>1.1.4.14.2.2</b>	Align and glue sensors to hybrid	12 w	Tue 3/30/04	Tue 6/22/04	669,85SS+40%,	\$705.00	3U	PhysicistF[25%],CMMF
673	<b>1.1.4.14.2.3</b>	Wirebond sensors to hybrid	12 w	Mon 4/5/04	Mon 6/28/04	672SS+4 d,63S	\$0.00	3U	WirebondingMachineF
674	<b>1.1.4.14.2.4</b>	<b>10/10 South Axial Module Production</b>	<b>0 w</b>	<b>Mon 6/28/04</b>	<b>Mon 6/28/04</b>	<b>673</b>	<b>\$0.00</b>	<b>2U</b>	
675	<b>1.1.4.14.2.5</b>	Debug sensor module	12 w	Wed 4/7/04	Wed 6/30/04	673SS+2 d,35S	\$0.00	3U	PhysicistF,ElecTechSF
676	<b>1.1.4.14.2.6</b>	Burn-in sensor modules	12 w	Wed 4/14/04	Thu 7/8/04	675SS+1 w	\$0.00	3U	PhysicistU[20%],Modu
677	<b>1.1.4.14.2.7</b>	Evaluate and repair sensor modules	12 w	Wed 4/28/04	Thu 7/22/04	676SS+2 w	\$0.00	3U	ElecTechSF[20%],SAF
678	<b>1.1.4.14.2.8</b>	Perform quality assurance tests	12 w	Wed 5/12/04	Thu 8/5/04	677SS+2 w	\$0.00	3U	PostDoc,SASEQTestS
679	<b>1.1.4.14.2.9</b>	<b>10/10 South Axial Module Testing Cor</b>	<b>0 w</b>	<b>Thu 8/5/04</b>	<b>Thu 8/5/04</b>	<b>678</b>	<b>\$0.00</b>		

**WBS Definition-** On CMM, using fixtures align sensors and hybrid and glue all together

**M&S BOE-** Epoxy cost based on one 10cc mix per day with an anticipated cost of \$1500 for 20 liters of epoxy, including purity testing. In addition there will be 1 packet of silver epoxy used per day throughout this production, at \$11 each. Total epoxy cost is \$11.75/day.

**Labor BOE-** There are 168 staves and thus 168 10-10 axial modules in the detector, which means 84 modules per north and south barrel. Including 20% spares, a total of 100 modules will have to be produced.

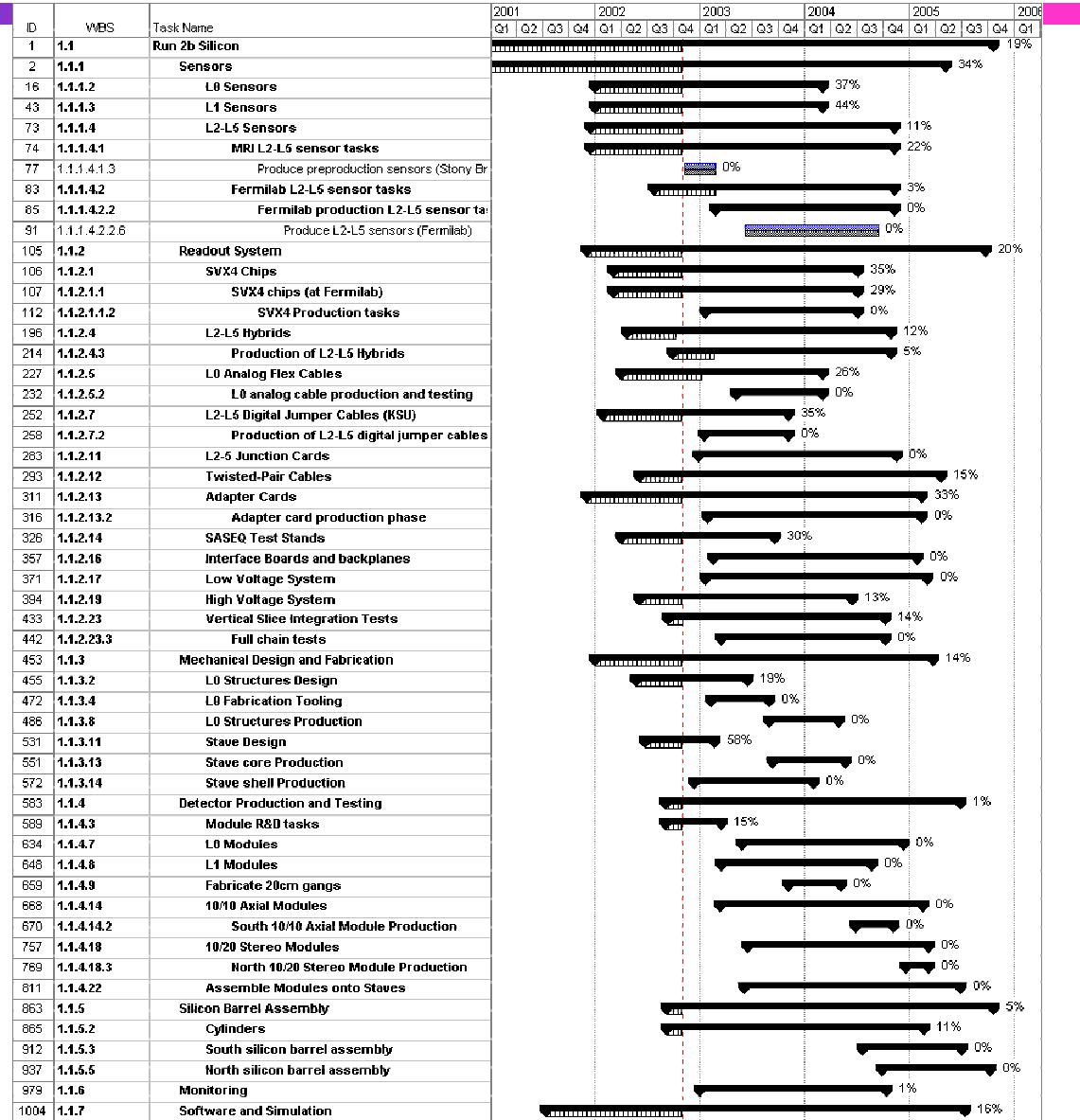
We foresee building 2 modules per day on one CMM. All modules can be produced in 10 weeks. To adequately train people and setup the procedures we expect that only one module will be built per day in the first week. One week is added to accommodate possible delays in part arrivals, equipment downtime or mishaps during production.

Production of a module, based on 2a experience, should take 1 hour of time for each of a mechanical technician and a CMM technician. The mechanical technician helps setting up and does the documentation and database entry. The following day a mechanical technician flips the module and makes the HV and ground connections and installs HV insulation and updates documentation. The latter operation will take 1 hour per module. A mechanical technician is thus assigned at the 50% level and a CMM operator at the 25% level. A senior Fermilab physicist oversees the production at 25%.



# Schedule Summary

Calls for having  
silicon detector ready  
to move to the D0  
assembly building  
(DAB) 7/22/05





# Schedule highlights

- ◆ Silicon Project dates for production and testing
  - SVX4 chip 5/22/03-4/5/04
  - L2-L5 Sensor 2/05/03-8/10/04
  - L2-L5 Hybrid 8/04/03-7/29/04
  - L2-L5 Module 3/30/04-12/7/04
  - Stave Core 7/11/03-1/08/04
  - Stave Assembly 8/09/04-3/14/05
  - Barrel Assembly with staves 11/22/04-7/7/05
- 
- ◆ Silicon Ready to Move to DAB 7/22/05



# L0/L1 Schedule

## L0 Summary

**L0 Complete 12/3/04**

Task Name	Duration	Start	2002				2003				2004				2005			
			Q1	Q2	Q3	Q4												
Production of L0 Sensors	40 w	Thu 2/20/03																
Production of L0 hybrids	62.2 w	Wed 2/5/03																
L0 analog cable production and testing	42 w	Wed 2/5/03																
L0 Structures Design	53 w	Thu 2/21/02																
L0 Fabrication Tooling	26.6 w	Tue 11/12/02																
L0 Structures Production	32.2 w	Mon 6/2/03																
L0 Modules	38 w	Wed 12/3/03																
South L0 Barrel Assembly	14 w	Mon 5/10/04																
North L0 Barrel Assembly	14 w	Wed 8/25/04																
L0 North Complete	0 w	Fri 12/3/04																

## L1 Summary

**L1 Complete 11/17/04**

Task Name	Duration	Start	2002				2003				2004				2005			
			Q1	Q2	Q3	Q4												
Produce L1 sensors	20 w	Thu 4/17/03																
L1 Hybrid Production	34 w	Tue 6/3/03																
L1 Structures Design	38 w	Thu 5/9/02																
L1 Fabrication Tooling	34 w	Tue 2/18/03																
L1 Structures Production	34.2 w	Fri 10/17/03																
L1 Modules	16.2 w	Thu 1/29/04																
South L1 Barrel Assembly	12 w	Fri 4/23/04																
North L1 Barrel Assembly	12 w	Wed 8/26/04																
L1 North Complete	0 w	Wed 11/17/04																

**L0/L1 Complete 1/4/05**



# L2-L5 Schedule Summary

## Overall L2-L5 Production

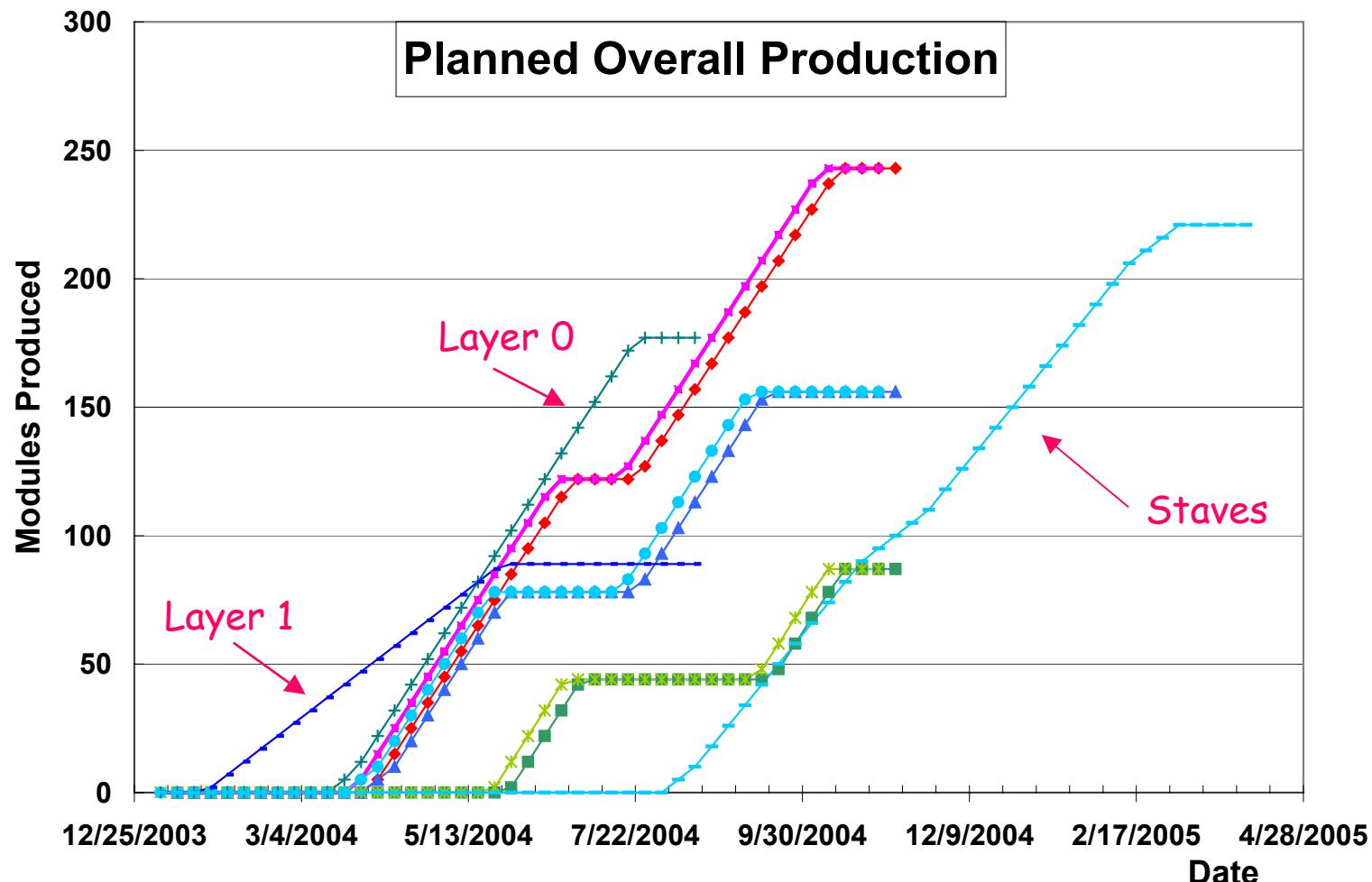
ID	WBS	Task Name	Duration	2002			2003			2004			2005			2006		
				Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
85	1.1.1.4.2.2	Fermilab production L2-L5 sensor ta	84 w															
112	1.1.2.1.1.2	SVX4 Preproduction and Production	71.6 w															
214	1.1.2.4.3	Production of L2-L5 Hybrids	103.8 w															
551	1.1.3.13	Stave core Production	34 w															
659	1.1.4.9	Fabricate 20cm gangs	24 w															
670	1.1.4.14.2	South 10/10 Axial Module Production	18.2 w															
789	1.1.4.18.3	North 10/20 Stereo Module Production	11.2 w															
851	1.1.4.22.7.3	Assemble North L2-L3 Staves	8.1 w															
952	1.1.5.5.8	North L2-L5 barrel assembly	16.1 w															
964	1.1.5.9	Silicon Ready To Move To DAB	0 w													0.2 w	7/22	

ID	WBS	Task Name	Duration	2002			2003			2004			2005			2006		
				Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
659	1.1.4.9	Fabricate 20cm gangs	24 w															
670	1.1.4.14.2	South 10/10 Axial Module Production	18.2 w															
680	1.1.4.14.3	North 10/10 Axial Module Production	18.4 w															
693	1.1.4.15.2	South 10/20 Axial Module Production	11.2 w															
703	1.1.4.15.3	North 10/20 Axial Module Production	11.2 w															
715	1.1.4.16.2	South 20/20 Axial Module Production	14.2 w															
725	1.1.4.16.3	North 20/20 Axial Module Production	14.2 w															
737	1.1.4.17.2	South 10/10 Stereo Module Production	18.2 w															
747	1.1.4.17.3	North 10/10 Stereo Module Production	18.2 w															
759	1.1.4.18.2	South 10/20 Stereo Module Production	11.2 w															
769	1.1.4.18.3	North 10/20 Stereo Module Production	11.2 w															
781	1.1.4.19.2	South 20/20 Stereo Module Production	13.8 w															
791	1.1.4.19.3	North 20/20 Stereo Module Production	14.2 w															
818	1.1.4.22.5.2	Assemble South L4-L5 Staves	11.4 w															
828	1.1.4.22.5.3	Assemble South L2-L3 Staves	8.1 w															
841	1.1.4.22.7.2	Assemble North L4-L5 Staves	11.4 w															
851	1.1.4.22.7.3	Assemble North L2-L3 Staves	8.1 w															
862	1.1.4.23	Stave Production Complete	0 w													◆ 3/14		

L2-L5  
Module and  
Stave  
Assembly

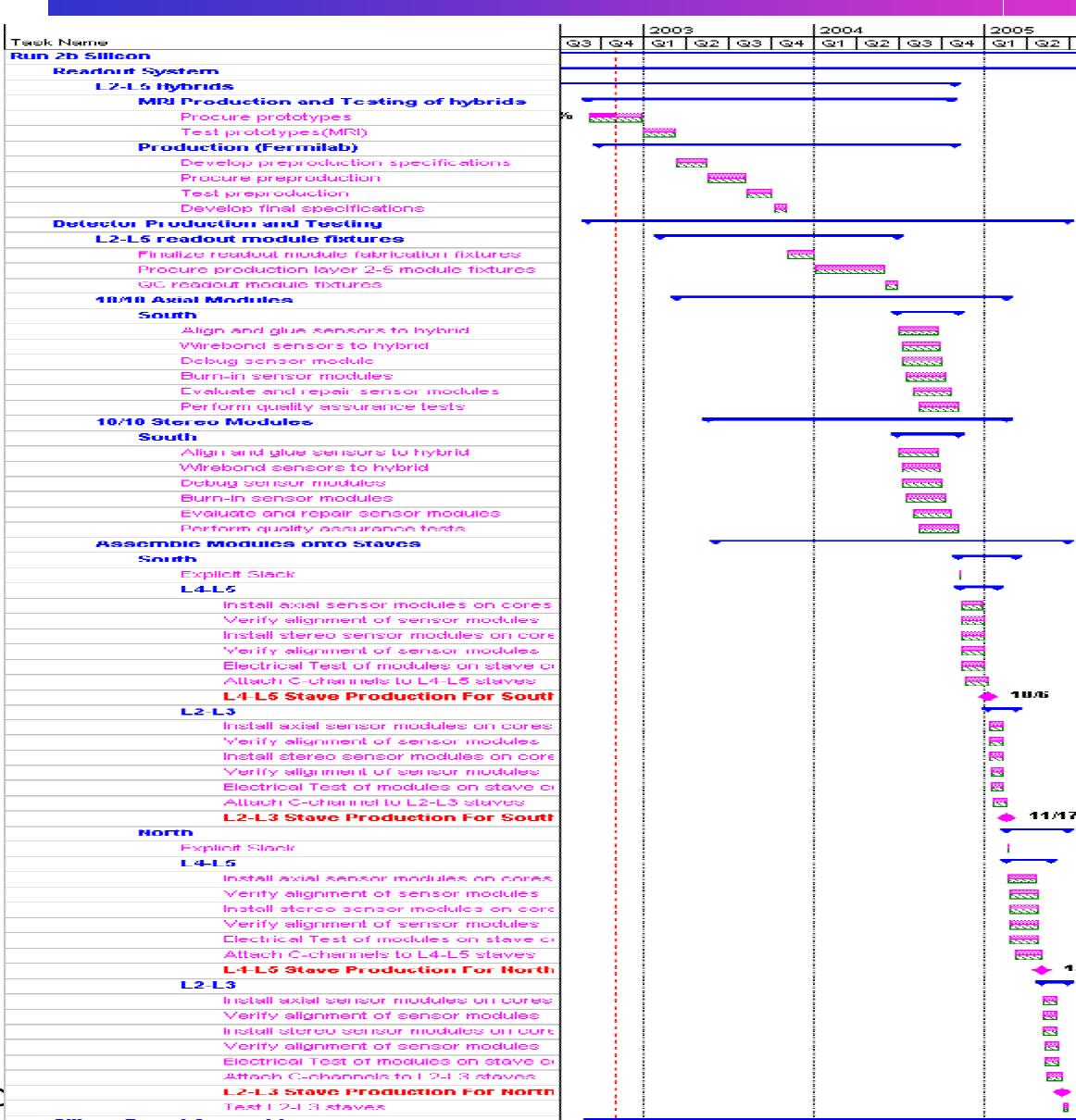


# Overall Production Timeline





# Critical Path



Hybrids drive the critical path at the beginning as they wait for SVX4 design

Module assembly and then stave assembly are on the critical path



# Critical Path - 2

The critical path is: Hybrids → Modules → Staves → Barrel Assembly

Hybrids wait for SVX4 design decisions

ID	WBS	Task Name	Duration	Start	2004				2005				2006		
					Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
863	1.1.5	Silicon Barrel Assembly	154.9 w	Mon 6/10/02											
937	1.1.5.5	North silicon barrel assembly	42.7 w	Wed 8/25/04											
952	1.1.5.5.8	L2-L5 barrel assembly	10.1 w	Tue 3/15/05											
954	1.1.5.5.8.2	Install staves in north support cylinder	4 w	Tue 3/29/05											
955	1.1.5.5.8.3	Verify stave alignment	1 w	Tue 4/26/05											
956	1.1.5.5.8.4	Final electrical test of north layers 2-5	3 w	Tue 5/3/05											
958	1.1.5.5.10	Mate L0-L1 with L2-L5, north	2 w	Tue 5/24/05											
959	1.1.5.5.11	Install Radiation monitors	1 w	Wed 6/8/05											
960	1.1.5.5.12	Final electrical test of north silicon	3 w	Wed 6/15/05											
961	1.1.5.6	North Silicon Complete	0 w	Thu 7/7/05										◆ 7/7	
963	1.1.5.8	Prepare for shipment	2 w	Fri 7/8/05										◆ 7/22	
964	1.1.5.9	Silicon Ready To Move To DAB	0 w	Fri 7/22/05											



# Slack

- Hybrid is on the critical path waiting for SVX4 design to be frozen.

Tasks with slack less than 20w	Slack Time (wks)
L2-L5 Hybrids	Critical
10-10 axial modules	Critical
SVX4 chips	3.5
L2-L5 Sensors	6
Other Modules	4-9
South L2-L5 Assembly	12
Cylinder Production	12
Fab. 20cm sensor gangs	19



# Sensitivity (long)

Description	additional duration (wks)	End Date	Shift(wks)
<b>Nominal Schedule</b>			<b>22-Jul-05</b>
Third SVX4 prototype	34	22-Feb-06	30.5
Third L2-5 Hybrid prototype	28	17-Feb-06	30
Third Analog Cable prototype	24	22-Jul-05	0
Second Digital Cable prototype	32	22-Jul-05	0
Second Junction Card prototype	16	22-Jul-05	0
Third Twisted Pair prototype	40	22-Jul-05	0
Third Adapter Card prototype	30	22-Jul-05	0
Second Purple Card prototype	20	22-Jul-05	0
Fabrication LO South structure	40	22-Jul-05	0
LO North+South sensor mounting	20 (each)	22-Jul-05	0
Fabrication L1 South structure	30	22-Jul-05	0
L1 North+South sensor mounting	20 (each)	22-Jul-05	0
HPK Looses 600 sensors	12	22-Jul-05	0
All of the above: the unpredictable		21-Aug-06	56



# Sensitivity (short)

Task	Description	reduction in		
		duration (wks)	End Date	Shift (wks)
<b>Nominal Schedule</b>			<b>22-Jul-05</b>	
89	No second SVX4 prototype	-34	22-Jul-05	0
156	No second L2-5 Hybrid prototype	-28	15-Jun-05	-5
252	No second Twisted Pair prototype	-40	22-Jul-05	0
266	No second Adapter Card prototype	-30	22-Jul-05	0
76	Production gain at HPK (600 sensors)	-12	22-Jul-05	0
<b>All of the above</b>			<b>1-Jun-05</b>	<b>-7</b>

Other Mitigations possible to compress schedule:

- Hybrids: Prototype testing assumed to take 10w starting 9/25/02, can start early with 1<sup>st</sup> batch of prototypes which are available now (Save 1 month)
- Staves: Can start mounting modules onto staves before all modules are complete (Save ~1 Month)
- SVX4 chips: Try and reduce testing time from 29 weeks, this also reduces hybrid stuffing time (potentially save 2 months)
- L2-L5 Sensors: Don't delay production sensor order from preproduction receipt (Save 3 months not on critical path)



# Milestones

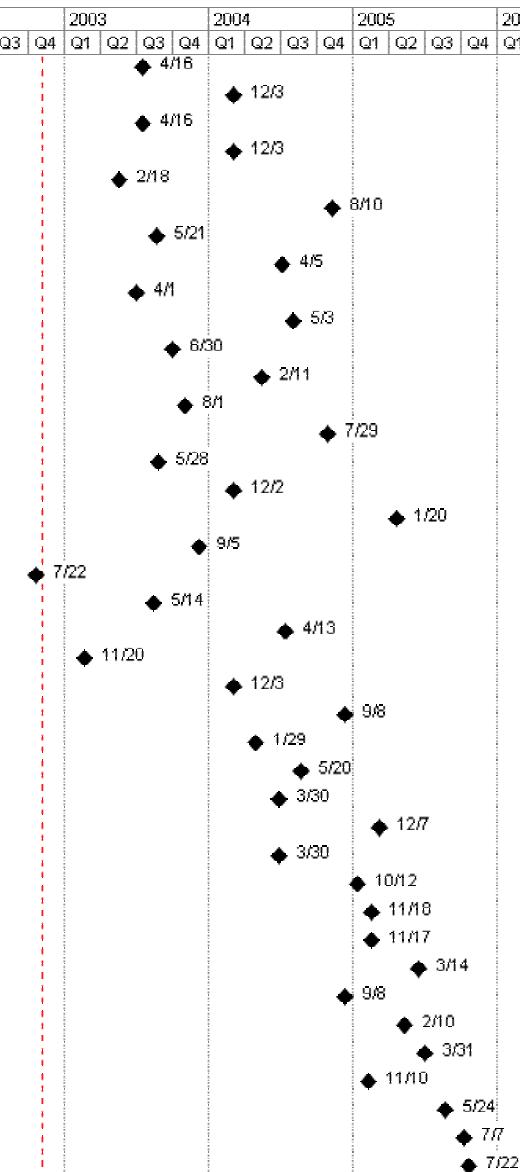
- There are 147 Milestones listed throughout the project
- In addition there are 15 Director's Milestones
- We have completed our first Milestone:
  - ◆ Readout of hybrid using SASEQ teststand  
7/22/02

WBS L3 Tasks	# of L2 milestones
1.1.1 Sensors	15
1.1.2 Readout	40
1.1.3 Mech Des.	11
1.1.4 Production	58
1.1.5 Barrel Ass.	14
1.1.6 Monitoring	3
1.1.7 Software	6



# Selected Project Milestones

ID	WBS	Task Name
38	1.1.1.2.5.4	L0 Sensors Released For Production
42	1.1.1.2.6	All L0 Sensors Delivered And Tested
70	1.1.1.3.5	L1 Sensors Released For Production
72	1.1.1.3.7	All L1 Sensors Delivered And Tested
90	1.1.1.4.2.2.5	L2-L5 Sensors Released For Production
99	1.1.1.4.6	All L2-L5 Sensors Delivered And Tested
137	1.1.2.1.6	SVX4 Released For Production
138	1.1.2.1.7	All SVX4 Chips Produced And Tested
146	1.1.2.2.2	L0 Hybrids Released For Production
163	1.1.2.2.6	L0 Hybrid Testing Complete
193	1.1.2.3.4	L1 Hybrids Released For Production
195	1.1.2.3.6	L1 Hybrid Testing Complete
224	1.1.2.4.4	L2-L5 Hybrids Released For Production
226	1.1.2.4.6	L2-L5 Hybrid Testing Complete
235	1.1.2.5.2.3	L0 Flex Cables Released For Production
238	1.1.2.5.3	L0 Flex Cable Production And Testing Complete
409	1.1.2.20	Downstream Readout Ready
432	1.1.2.22.4	Successful readout of full stave
439	1.1.2.23.2.2	Successful readout of hybrid with SASEQ tests
444	1.1.2.23.3.2	Successful Readout of Single Unit Full Chain
448	1.1.2.23.3.6	Successful readout of multiple staves with all fir
549	1.1.3.11.4	Prototype Mechanical Stave built
636	1.1.4.7.2	L0 Module Production Begun
647	1.1.4.7.13	L0 Module Testing Complete
650	1.1.4.8.2	L1 Module Production Begun
658	1.1.4.8.10	L1 Module Testing Complete
664	1.1.4.10	Module production for L2-L5 South begun
667	1.1.4.13	Module production and testing for L2-L5 North complete
671	1.1.4.14.2.1	L2-5 (10/10 South Axial) Module Production Beg
751	1.1.4.17.3.4	L2-5 (10/10 North Stereo) Production Complete
756	1.1.4.17.3.9	L2-5 (10/10 North Stereo) Module Testing Comp
838	1.1.4.22.6	South Staves Complete
861	1.1.4.22.8	North Staves Complete
926	1.1.5.3.5	L0-L1 South Complete
932	1.1.5.3.7	Layer 2-5 South Complete
936	1.1.5.4	South Silicon Complete
951	1.1.5.5.7	L0-L1 North Complete
957	1.1.5.5.9	Layer 2-5 North Complete
961	1.1.5.6	North Silicon Complete
964	1.1.5.9	Silicon Ready To Move To DAB



Sensors – 1.1.1

Readout – 1.1.2

Mech. Design – 1.1.3

Production – 1.1.4

Assembly – 1.1.5



# Cost Estimate

- Approach used for Cost Estimate
  - ◆ Strongly relies on RunIIa experience
  - ◆ Quotes are used wherever possible
  - ◆ University labor is included in the M&S costs
- Contingency follows general “project” guidelines unless noted in the basis of estimate
- Labor resources have been allocated according to the exact duration of the task. An overall efficiency factor of 0.7 has been applied (364 hrs/quarter) to calculate FTEs



# Costs

- In FY02\$ with no G&A and no contingency
- Costs are in kilo\$ as extracted from schedule

WBS	Name	M&S	FNAL labor	Total by WBS
1.1.1	Sensors	2,437	46	2,483
1.1.2	Readout	4,246	1175	5,421
1.1.3	Mech Des	581	550	1,131
1.1.4	Prod	186	818	1,004
1.1.5	Assembly	384	987	1,371
1.1.6	Monitoring	53	26	79
1.1.7	Software	15	0	15
1.1.8	Admin	160	337	497
<b>TOTAL</b>		<b>8,062</b>	<b>3,939</b>	<b>12,001</b>



# M&S Cost Drivers

- Sensors

- ▲ Production costs per sensor:

- ▲ L0 \$275

- ▲ L1 \$435

- ▲ L2-L5 \$470

Production TOTAL \$1.7M

- SVX4 chips \$1.0M

- Hybrids \$0.8M

- Cables

- ▲ Analog \$183K

- ▲ Digital Jumper \$475K

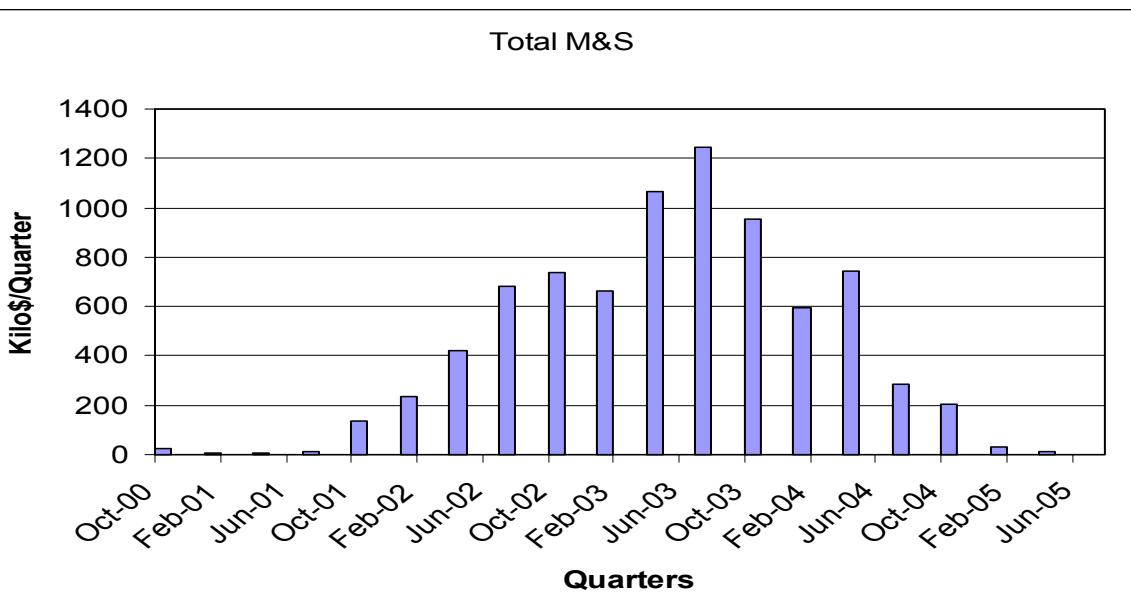
- ▲ Twisted Pair \$327K

TOTAL \$1.0M

Costs are in FY02 \$ with no contingency or G&A



# M&S Costs and Funding



FY02\$, no G&A, cont

Cost \$8.1M

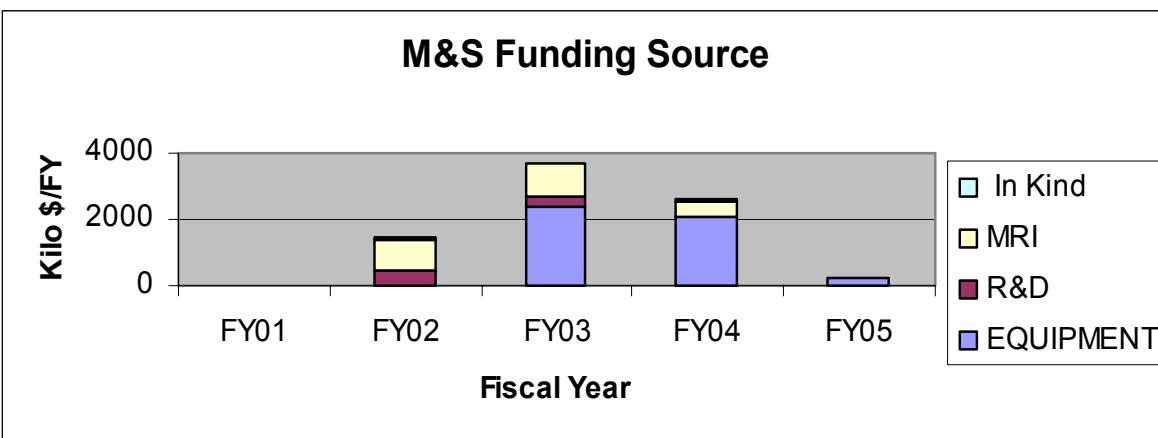
MRI \$2.4M

InKind \$0.1M

R&D \$0.9M

Equip. \$4.7M

□ Major Research  
Instrumentation (MRI)  
Grant secured from NSF



➤ \$1.6M of NSF  
equipment funds and  
\$800k of Cost Share by  
participating universities

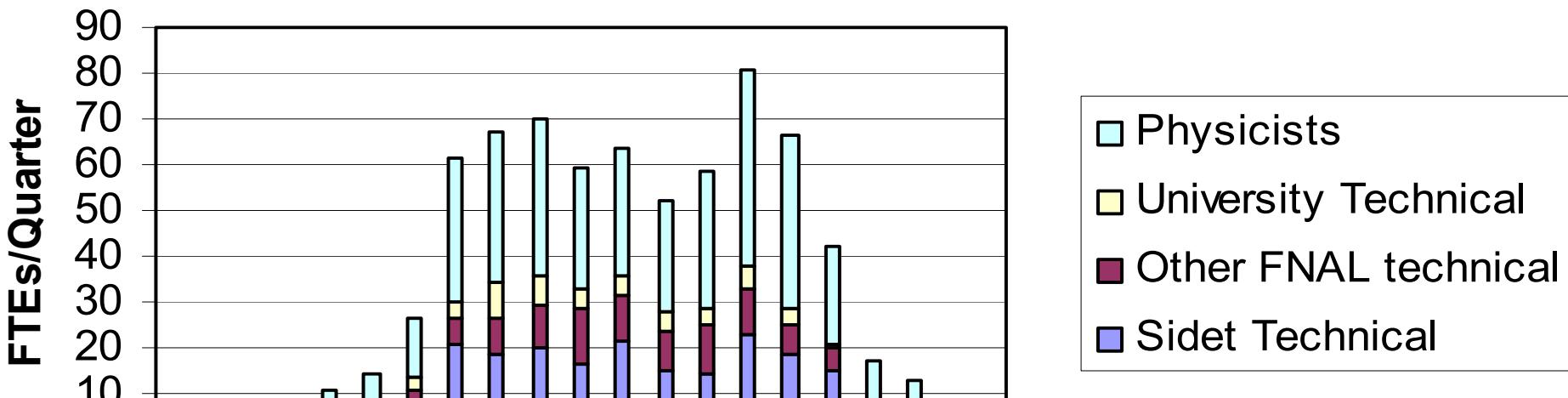


# Contingency

- Contingency is calculated for each task
- Contingency follows guidelines unless noted by task
- Selected M&S contingencies
  - ◆ Sensor production - 75%
  - ◆ SVX4 engineering at LBL - 100%
  - ◆ Fixtures - 100%
  - ◆ Total Silicon project 60%
- Labor Contingency
  - ◆ All are nominally set to 50%
  - ◆ Module production tasks have 100%
  - ◆ Other higher risk tasks have higher contingencies
  - ◆ Total Silicon Project 55%



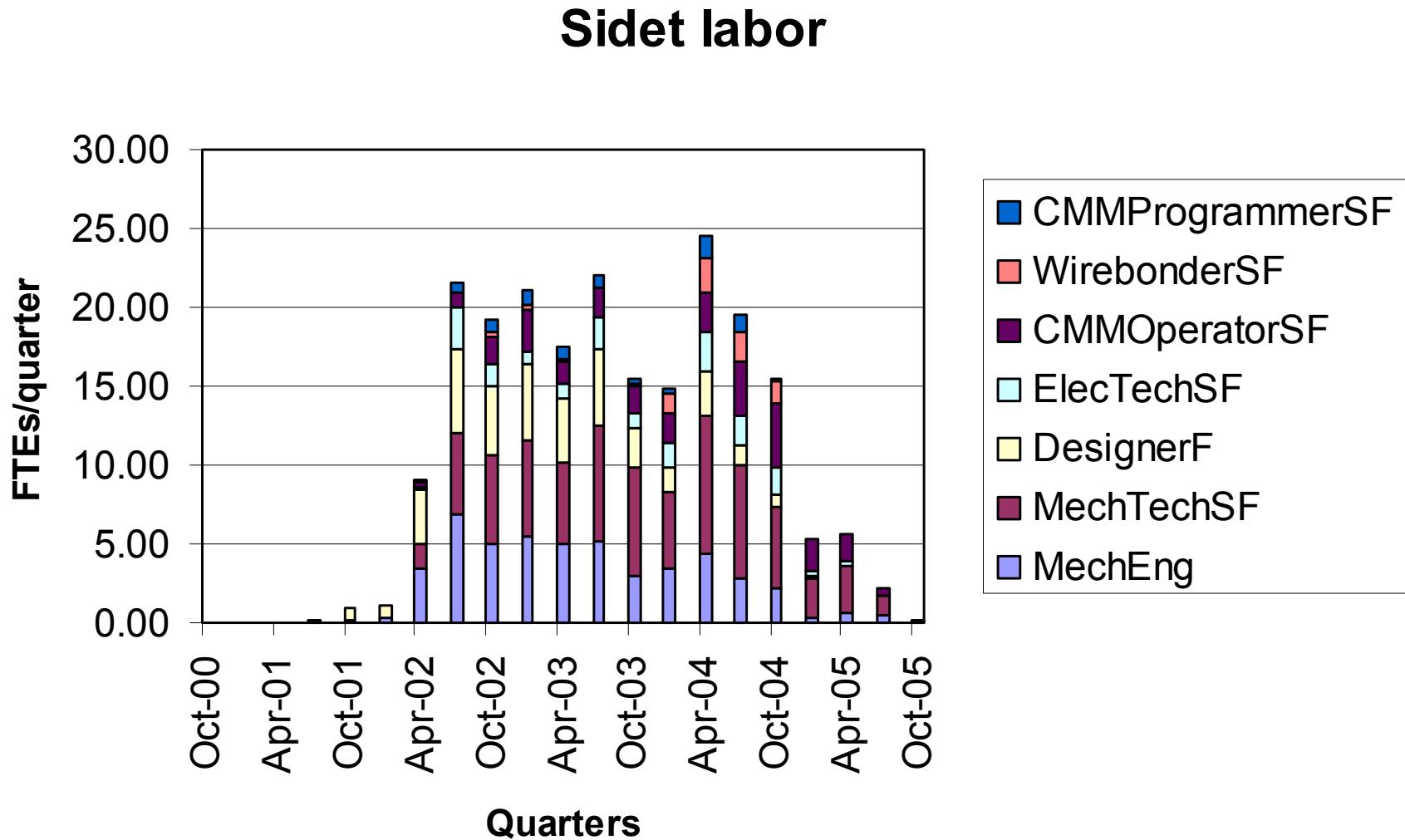
# Labor Hours and Profile



	Quarter	
• Physicists		137 khours
• Univ. Technical		19 khours
• Other FNAL technical		35 khours
• Sited Technical		76 khours
• TOTAL		267 khours
		94 FTE
		13 FTE
		24 FTE
		53 FTE
		184 FTE

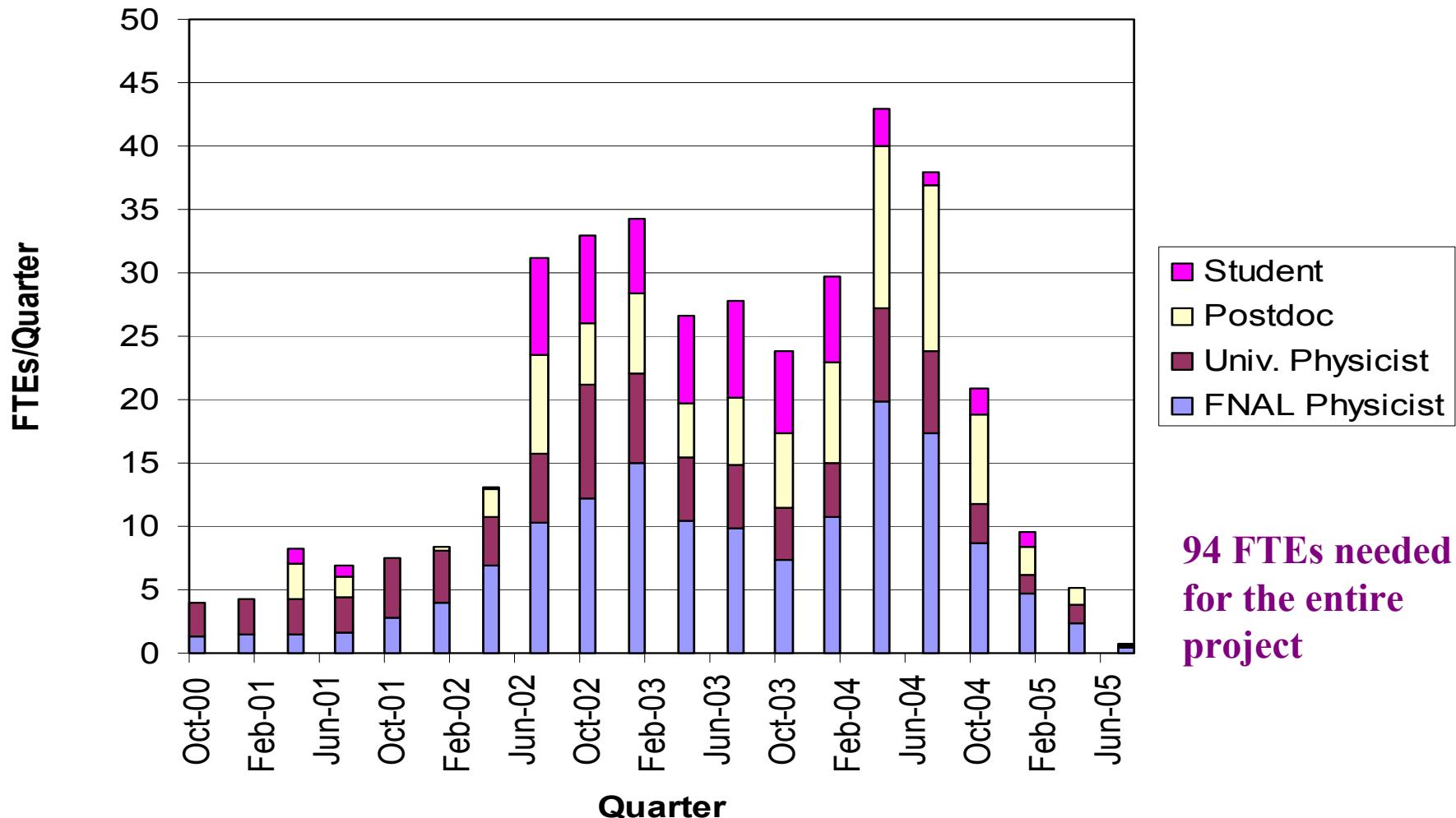


# Sidet Labor Profile





# Physicist Labor Profile





# Physicist FTEs Currently Working

• KSU	5.5	FNAL	7.5
• UW	2		
• SUNY SB	0.5		
• CINVESTAV	1		
• Moscow State	2		
• Kansas	4		
• UIC	2.5	TOTAL	33
• Fresno State	2		
• Brown	1	Total FTEs needed	
• Louisiana Tech	2		$94/3\text{yrs} = 31/\text{yr}$
• Northwestern	1		
• NIKHEF	1		
• Rice Univ.	1		



# Risk Analysis

- Risk analysis done on all WBS L4 tasks
- Risk Score = Probability \* Impact in each of 4 categories: Cost, Schedule, Technical, Scope
- Technical and Scope Risks are considered to be the same
- Cost impact determined as fraction of \$8M
- Schedule impact determined as fraction of 36 mo.

Impact Score	Cost Increase	Schedule Increase
0.05	<\$200K	<1 mo
0.1	\$200K-\$400K	1-2 mo
0.2	\$400K-\$800K	2-4 mo
0.4	\$0.8M-\$1.6M	4-8 mo
0.8	>\$1.6M	> 8 mo



# Risk Analysis Detail

## Examples from the Silicon Sensors (WBS 1.1.1) and Readout (WBS 1.1.2)

ID	WBS	Name	CRI	CRP	CRS	SchRI	SchRP	SchRS	ScpRI	ScpRP	ScpRS	TRI	TRP	TRS
1	1.1	Run IIb Silicon	0	0	0	0	0	0	0	0	0	0	0	0
2	1.1.1	Sensors	0	0	0	0	0	0	0	0	0	0	0	0
3	1.1.1.1	Probing Equipment Setup	0.1	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01
16	1.1.1.2	L0 Sensors	0.1	0.1	0.01	0.05	0.1	0.01	0.4	0.3	0.12	0.4	0.3	0.12
43	1.1.1.3	L1 Sensors	0.1	0.1	0.01	0.05	0.1	0.01	0.4	0.3	0.12	0.4	0.3	0.12
73	1.1.1.4	L2-L5 Sensors	0.8	0.1	0.08	0.4	0.3	0.12	0.1	0.3	0.03	0.1	0.3	0.03
105	1.1.2	Readout System	0	0	0	0	0	0	0	0	0	0	0	0
106	1.1.2.1	SVX4 Chips	0.4	0.5	0.2	0.8	0.5	0.4	0.4	0.3	0.12	0.4	0.3	0.12
139	1.1.2.2	L0 Hybrids	0.05	0.1	0.01	0.05	0.1	0.01	0.4	0.3	0.12	0.4	0.3	0.12
164	1.1.2.3	L1 Hybrids	0.05	0.1	0.01	0.05	0.1	0.01	0.4	0.3	0.12	0.4	0.3	0.12
196	1.1.2.4	L2-L5 Hybrids	0.4	0.3	0.12	0.4	0.3	0.12	0.4	0.3	0.12	0.4	0.3	0.12
227	1.1.2.5	L0 Analog Flex Cables	0.1	0.5	0.05	0.1	0.3	0.03	0.4	0.5	0.2	0.4	0.5	0.2
239	1.1.2.6	L0-L1 Digital Jumper Cables (KSU)	0.1	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01	0.2	0.1	0.02
252	1.1.2.7	L2-L5 Digital Jumper Cables (KSU)	0.2	0.1	0.02	0.05	0.1	0.01	0.05	0.1	0.01	0.2	0.1	0.02
265	1.1.2.9	Testing of cables (LA Tech)	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01
273	1.1.2.10	L0-L1 Junction Cards	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01
283	1.1.2.11	L2-5 Junction Cards	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01
293	1.1.2.12	Twisted-Pair Cables	0.2	0.3	0.06	0.1	0.1	0.01	0.4	0.3	0.12	0.4	0.3	0.12
311	1.1.2.13	Adapter Cards	0.2	0.3	0.06	0.1	0.1	0.01	0.4	0.3	0.12	0.4	0.3	0.12
326	1.1.2.14	SASEQ Test Stands	0.4	0.1	0.04	0.1	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01
357	1.1.2.16	Interface Boards and backplanes	0.1	0.1	0.01	0.05	0.1	0.01	0.1	0.3	0.03	0.1	0.3	0.03
371	1.1.2.17	Low Voltage System	0.1	0.1	0.01	0.05	0.1	0.01	0.1	0.3	0.03	0.1	0.3	0.03
390	1.1.2.18	High-mass Cables	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01	0.05	0.1	0.01
394	1.1.2.19	High Voltage System	0.2	0.1	0.02	0.05	0.1	0.01	0.1	0.3	0.03	0.1	0.3	0.03
410	1.1.2.21	Support of Downstream electronics at Fermilab	0.05	0.1	0.01	0.05	0.1	0.01	0.1	0.3	0.03	0.1	0.3	0.03
428	1.1.2.22	Stand-alone system integration test	0.05	0.1	0.01	0.1	0.3	0.03	0	0.3	0	0	0.3	0
433	1.1.2.23	Vertical Slice Integration Tests	0.05	0.1	0.01	0.1	0.3	0.03	0	0.3	0	0	0.3	0



# Highest Risk Items

- Examined all Risk Scores over 0.18 on any of cost, schedule, technical/scope

Task	Cost Imp	Cost Prob	Sch Imp	Sch Prob	Tech Imp	Tech Prob
SVX4 chips	0.4	0.5	0.8	0.5	0.4	0.2
Analog Cables	0.1	0.5	0.1	0.3	0.4	0.5
LO Struct Des.	0.05	0.5	0.05	0.3	0.4	0.5
Int of LO/L1	0.1	0.1	0.05	0.3	0.4	0.5
LO Modules	0.05	0.5	0.05	0.7	0.4	0.5
Assemble Stave	0.05	0.5	0.2	0.5	0.4	0.5
S/N Barrel Ass.	0.05	0.5	0.1	0.5	0.4	0.5



# Comments on Risk

- SVX4 chips
  - ◆ Significant cost and schedule impact
  - ◆ Risk is that we will need another run of chips, not that the chip won't work (we see it does)
- LO Components
  - ◆ Significant Technical/Scope impact
  - ◆ Noise, assembly issues difficult
- Stave/Barrel Assembly
  - ◆ Significant Technical/Scope impact
  - ◆ At this point there is a lot of accumulated cost, and this is the last point in the assembly
- For these tasks we will make sure there is extensive R&D and testing!



# Conclusions

- Management structure with 8, L3 groups
- Resource loaded schedule constructed using experience from RunIIa
- Silicon Ready to move to DAB 7/22/05
- Cost of M&S + Labor without contingency in FY02\$ with no G&A: \$12M
- Number of FTEs needed: 184
  - ◆ We believe we can build the detector on cost, and on schedule!